Farm and Factory Leaf Curing Technology of Our Processing

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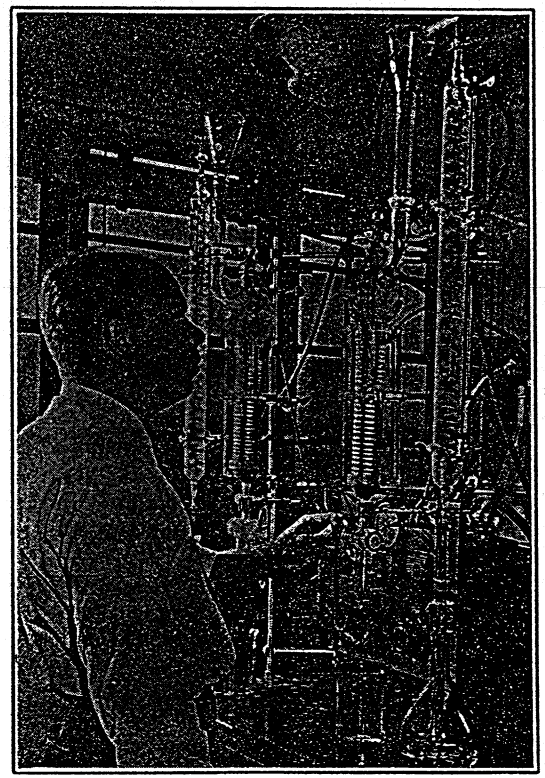
TOBACCO technology is a broad title, and includes a great deal of agricultural science, manufacturing know-how, and mechanical and engineering achievement. In the latter group are included some of the finer accomplishments of the mechanic and engineer. It is difficult to find a more intriguing mechanism than the modern cigarette-forming and -packaging machine. It is only equaled by the modern cigar-making machine that produces 13 cigars a minute with the finesse of an old-time Cuban hand roller. The mechanic and engineer have contrived to develop machines for stemming, packing, wrapping, and now for selling the product, and changing money for the customer, that are marvels of this industrial age.

Technology on the tobacco farm started at Jamestown, Virginia. It has become increasingly important with each succeeding generation. Few tobacco farmers would consider themselves tobacco technologists, yet they require a broader understanding of natural phenomena than most other trades. Good farming practices, combined with a knowledge of the biological processes of the tobacco plant, of insects, and of microorganisms, are necessary to grow a crop of tobacco and to cure it properly.

Color, Aroma, Finish

Flue-cured tobacco requires good judgment to know how much nitrogen fertilizer to feed the crop, so that it will ripen and mature a leaf of a lemon color, good aroma and finish. It is both a science and an art to operate the curing barns, so that the several definite chemical changes, that take place under each set of conditions of temperature and humidity, will produce, in the end, the proper shade of yellow color, and the texture and finish desired. It is difficult to find in all agriculture another crop that requires the



(Photograph by M. C. Audsley)

WILLITS - CONNELLY MODIFICATION OF THE GRIFFITH-JEFFREY STEAM DISTILLA-

temperatures and humidity inside the barn during the successive stages of the cure.

Since then, the heating engineer has come in with his thermostats, and his stokers for hard or soft coal, kerosene and the heavier oils, and now bottled gas, or gas piped from a town near by. The thermostat and regulated fuel feed have produced a distinct change for the better in the economic and social life of the flue-cured grower. The automatic control is automatic enough to allow the barn attendant to get some needed rest during his season of hardest work. The heat control, obviously, is very much better than that which is secured in the old wood burning furnace, which has to rely upon the human eye and a one dollar thermometer.

All in 34 Years

Progress in curing the air-cured types has not been as rapid. The charcoal fires on the barn floor, used to wilt the shade-grown wrapper, is still standard practice. Some 34 years ago the writer was identified with an experiment in air conditioning in which manufactured weather supplied properly conditioned air to shade tobacco curing units. Excellent color, texture, and body were secured, and fine tobacco was cured in 5 to 7 days, instead of the usual 30 to 40 days required under natural conditions, plus charcoal fires.

However, the cost of a large scale modern air conditioning unit, which is used only for a relatively short time during the year, is prohibitive. Since then, modifications of the charcoal fire system have been tried. Warm air has been blown into the barn. Modifications, employing humidified air, have been used. But, because of engineering difficulties and high costs, they have not come into general use. One of the leading engineers in the tobacco trade aptly described the situation: "Charcoal requires no overhead."

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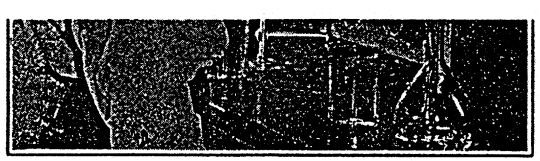
Trial and Error

Beyond the grower's art there is the science eveloped by the experiment stations and the ederal Department of Agriculture to interpret what the farmer has achieved by trial and error. The tobacco farmer, in recent years, has found quick and helpful aid from the trained scientists for many of the problems that have come upon him suddenly. In this category are several plant diseases that are acquiring increasing importance, and old-time insects that are reasserting themselves in an apparent endeavor to achieve world dominance.

Flue-curing has developed, within the past decade, from the wood burning era to the most modern coal stoker and advanced oil burner. Thanks to the heating engineer the flue-cured grower can get to bed, something that he was unable to do while he had tobacco to cure. A decade ago the flue-cured tobacco grower had urgent business at his tobacco barn 24 hours a day, firing it with wood, and using his experience, which allowed him to put the right quantity of dry, cord wood into his furnaces at the right time, so that he could secure the proper



(Photograph by M. C. Audsley)

WILLITS - CONNELLY MODIFICATION OF THE GRIFFITH-JEFFREY STEAM DISTILLATION APPARATUS

This type of still for nicotine distillation was first designed by Griffith and Jeffrey (see Analytical Chemistry, Vol. 20, p. 307—April, 1948). It reduced the time required for a nicotine distillation to about ten minutes per sample and facilitated the introducion and disposal of samples. Willits and Connelly, at the Eastern Regional Research Laboratory, have improved the original design by using an all glass apparatus and a ribbon heating element wound directly on the distillation chamber. They have adapted it for analysis of larger samples, and facilitated the cleaning by use of larger bore stopcock.

Some of the technological phases of curing and processing tobacco on the farm and in the factory are briefly described. A short historical statement is given of the origin and development of the tobacco chemists' conference, and some of the accomplishments are mentioned.

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Fires Required

For curing stalk-cut tobacco, such as the Connecticut broadleaf and Havana seed and burley types, charcoal and briquet coal fires are used to a limited extent. An important discovery, however, reveals that circulating air in an air-cured tobacco barn usually is sufficient to prevent the excessive development of damaging microorganisms on the leaf and stems during the sap condition. If the growth of these organisms was not inhibited, pole sweat and house burn would result. Boxes of about the size of a cigar leaf case, containing a fan of large volume with suitable baffles, have been developed to keep the air circulating in the barns during moist weather when molds and rots are most likely to develop. It is the only notable improvement in air curing.

Importance of Moisture

Moisture is, perhaps, the most important item to the tobacco technologist. The farmer takes it out of the green plant when he cures it, and puts back some when he takes it down to sort it and prepare it for market. The buyer reduces the moisture immediately after he gets it, so he can store it in the hogshead; with cigar tobacco he can only hope he has the right amount of moisture in the leaf, so it will sweat in the box or bundle. When the tobacco reaches the

manufacturer for processing, moisture is added to it, so it can be handled without breakage for dipping, blending and cutting, or with cigar filler tobacco for resweating. It may then have to have its moisture reduced for safe product storage. This last requires a chemist, a metallurgist, a paper maker, and a cellophane expert.

Probably no other item requires as much attention and costs so much to adjust as tobacco moisture. There may be too much or too little, and it costs money to get it right. One of the outstanding achievements of tobacco engineering is the modern drying and conditioning machine. Through this machine pass nearly all of the burley, flue-cured, and Maryland tobacco fresh from the farm; here it is properly conditioned for the aging process. The machine may be used again when the leaf is ready for final processing into cigarettes and smoking tobacco. It also could be made an important adjunct in cigar tobacco where the leaf is packed for the customary natural sweat, to insure against black rot, and to secure a more uniform fermentation.

Eliminates the Breakage

The introduction of a vacuum machine, used when the tobacco hogshead or bale comes to the factory from leaf storage, has eliminated breakage by putting the proper amount of moisture into the leaf quickly. It accomplishes in minutes what required days in the old-time steam room.

A machine has been devised for handling large quantities of fine cigar wrappers. This device carries the separated hands of tobacco through the machine in a moist atmosphere, and, with a little shaking to expose all of the leaves in the hand, it delivers them at the end soft and pliable, free of torn leaf and water damage. It is used in the Connecticut Valley and in Sumatra in the packing establishments, and in some of the larger cigar factories. Under the old hand method the leaf is shaken and sprayed under a fine mist. Water spotting and breakage often resulted, and several subsequent shakings might be required to bring the leaf to proper condition by steaming.

Varied Moisture Content

Moisture continues to be important to the manufacturer after his finished product is packed. The development of cellophane has eased, but certainly not eliminated, the problem. Cigars smoke best when they carry about 16 per cent moisture. Blended cigarettes should have about 12 percent, pipe tobacco 16 percent, mouldy cigars after they were in cellophane for a few weeks. He had to learn a new technique, and dry his cigars to a safe condition in the factory before he put them into the cellophane tubes. The cigarette manufacturer put on a double wrapper, and finally got a cellophane that better retards moisture loss. The only successful solution, to this phase of moisture control, is to have the product sell fast enough over the counter, so that stocks are replenished every few days. A tobacco salesman, and not a tobacco chemist or technologist, is needed at this point.

Enter the Chemist

The rather complex tobacco technology has developed naturally. Much of the factory technology is correlated with the farm technology. The manufacturer of tobacco products will continue to be an art, since human tastes largely determine their ultimate consumption. A leading manufacturer once described the accomplishments of his chemists. "So far, they have shown us that what we have been doing has been right." However, the tobacco chemist has made a place for himself in the modern factory. There are not yet enough of them for the industry to appreciate fully their importance and value. A few of the early tobacco chemists came in through the back door from the nicotine factory. Much of the European work has been done by the government regie chemists.

The wonderful progress made in tobacco engineering is no doubt due to the efforts of many inventive mechanics, machinists, and engineers, with a few outstanding inventors to initiate the fundamental ideas. The same has been true in some phases of the agricultural developments; with the increasing personnel in that part of the industry the future advances should increase even more rapidly than that which transpired during the past three decades.

The Tobacco Research Council, which has been meeting for the past 25 years in the southern tobacco States, has accomplished much for the tobacco grower. Tobacco agronomists, physiologists, plant breeders, and soil chemists come to these meetings. In more recent years the pathologists, nematologists, and entomologists have become important participants. Now the engineers, especially interested in curing devices and in tillage, spray, and dusting machinery, plan to join the group.

Met in Philadelphia

chemists marks a real advance for the American tobacco industry. Although much of the work of the factory laboratory is of a confidential nature, there have been found many items that are of common interest and of considerable value to the whole industry.

At the first Philadelphia meeting one of the members of the conference described the factory laboratory to be actively concerned with analytical and control problems. He stated that "to insure uniformity and high quality the laboratory has to examine the sugars, glycerine, honey, chocolate, licorice, balsams and essential oils. It is also necessary to test wrapping materials, such as wax paper, laminated papers, pliofilm and cellophane, the porosity and other characteristics of cigarette papers. Control problems are of constant concern, including moisture through all of the processes and other factors concerned with the product, as well as to keep watch of the progress of aging and fermentation of the leaf in storage.

"The factory chemist is vitally interested in research. He must be a bacteriologist for fermentation study, a mycologist to handle the mold spoilage problem, an entomologist for the tobacco beetle and tobacco moth, a cook and a perfumist. He also has to study the alkaloids and other organic compounds occurring in the leaf and in the combustion products in the smoke, and he further has to be something of a psychologist to examine the causes and cures of irritants."

Progress Is Made

Much has already developed out of these meetings. Improved methods for insect control have been put into effect in several factories; a better understanding of some of the phenomena of fermenting cigar tobaccos has been secured; knowledge has been gained of how and where the alkaloids are formed in the plant; information continues to be accumulated regarding the several alkaloids, other than nicotine, in the different varieties of tobacco. Another has come an appreciation that the tobacco plant may supply something besides a good chew or smoke, since rutin, a valuable drug, has been isolated from flue-cured tobacco and nicotinic acid, one of the vitamins, has been found in sweated cigar leaf.

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Cigar store clerks, at one time, had to know some physical chemistry to maintain the proper moisture conditions in the cigar and wall cases where the tobacco products were displayed. Absorbent bricks and spongs, asbestos and clay tubes, and, best of all, glass trays containing a saturated solution of a mixture of potassium nitrate and ammonium chloride, were used to secure a suitable relative humidity in these display cases—until cellophane appeared about 25 years ago.

Cellophane introduced a new technology to the manufacturers of tobacco products. The cigar maker, anticipating the drying conditions on the retailer's shelf and in the cigar cases, packed his product a little soft. He encountered

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Met in Philadelphia

The tobacco factory chemists and others interested in the chemistry of processed tobacco met at the Eastern Regional Research Laboratory in suburban Philadelphia in 1947, and again in 1948. The third session, in 1949, was held at the Medical College of Virginia, at Richmond, with the Richmond manufacturers joining with the college as hosts. It is planned to hold the 1950 session at Pennsylvania State College.

Other industries have benefited greatly by having their chemists meet together. There are associations of rubber chemists, oil chemists, food and petroleum chemists, to mention only a few of them. Some of the technological advances that have been made in these fields are apparent to all, and everyone in the industries has been helped.

For the Whole Industry

The organization of this group of tobacco

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The conferences have made available to the industry the most recent methods of analyses of nicotine and other alkaloids of tobacco. The use of the ultraviolet absorption spectra, for the determination of nicotine, has shortened many fold the time required, as well as increased the accuracy. Chromatographic methods are being developed for the separation and identification of the several tobacco alkaloids, which heretofore has been a most difficult procedure.

Fundamental research has contributed papers on the transformation products of the alkaloids, a study of the rearrangement of nicotine oxide, the photochemical oxidation of nicotine, and studies on nicotine absorption in the body.

The future for tobacco chemistry in the United States appears bright. With the increase in the number of chemists, that are expected to be needed, as management appreciates the chemists' work, more will be accomplished, and technology will improve throughout the tobacco industry.